2016 National Survey of Children's Health

Nonresponse Bias Analysis

U.S. Census Bureau
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Note 1: This report's analyses and its discussions strove to follow a large portion of the Nonresponse Bias Analysis (Appendix XIII) of the *Design and Operation of the National Survey of Children with Special Health Care Needs, 2009–2010* (Bramlett et al., 2014). Since the goals of the two nonresponse bias analyses are the same, text between the two documents are often similar.

Note 2: Nonresponse and noninterview are often used interchangeably throughout this document, as are frame variable, variable, and characteristic; when necessary, distinctions are made.

Analysis of Nonresponse Bias in the 2016 National Survey of Children's Health

I.   Nonresponse in the 2016 National Survey of Children's Health

<u>Motivation</u>

Standard 1.3 of the Office of Management and Budget Standards and Guidelines for Statistical Surveys (2006) states that "Agencies must design the survey to achieve the highest practical rates of response, commensurate with the importance of survey uses, respondent burden, and data collection costs, to ensure that survey results are representative of the target population so they can be used with confidence to inform decisions." Implicit in this standard is the assumption that the frame variables (e.g., stratum) used at the design state are sufficiently predictive of the collection variables (e.g., number of eligible children in the household) for this to be feasible. Under this assumption, standard nonresponse bias analysis techniques are applied to study potential areas of nonresponse bias in the survey estimates.

Three goals of this analysis of nonresponse bias in the 2016 National Survey of Children's Health (NSCH) are:
*   To describe how the 2016 NSCH Screener and Topical nonrespondents are different from their respective Screener and Topical respondents.
*   To describe how well the 2016 NSCH Screener and Topical weighting adjustments that were used to correct for nonresponse performed.
*   To present and discuss the effect of nonresponse, and the weighting corrections for nonresponse, on selected key survey estimates (KSEs).

Using frame information (i.e., NSCH Screener response data, NSCH frame data, and block group-level or tract-level frame data from the American Community Survey (ACS))[1], information from respondents is compared to all of the cases eligible for the Screener and for the Topical.

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[1] A census block group is a geographical unit used by the U.S. Census Bureau and it is the smallest geographical unit for which the Census Bureau publishes sample data. A single block group consists of clusters of blocks within the same census tract and each tract contains at least one block group. It usually covers a contiguous area, and never crosses state, county, or census tract boundaries, but may cross the boundaries of any other geographic entity; it is generally defined to contain between 600 and 3,000 people.

Since most of the frame information is available for both respondents and nonrespondents of the Screener and Topical stages, the stage-specific nonresponse bias in these frame variables can be measured directly. The overall nonresponse bias for the survey is then estimated for the frame variables and logistic regression models are used to translate the estimated overall biases in the variables into estimates of bias in the KSEs.

A comparison of response rates across the frame variables, comparing above and below the median, could indicate the presence of nonresponse bias in the 2016 NSCH. (Note: Percent Owner is an example of a frame 'variable' or 'characteristic'; an example of a 'subgroup' is greater than the median for the frame variable Percent Owner.) If the response rate is lower (or higher) for a particular subgroup relative to that of other subgroups, then that would indicate that the subgroup is under-represented (or over-represented) in the final sample, and, to the extent that a KSE is different for that particular subgroup compared with other subgroups, there would be bias in the overall survey estimate. If the response rate is the same across subgroups, or if a KSE does not differ by these subgroups, the KSE could still be biased, but unequal response rates across these subgroups will have been ruled out as a source of bias.

Weighting Framework and the Types of Nonrespondents at each Stage

As presented in the Source and Accuracy Statement for the 2016 NSCH, Figure 1 provides a framework for the weighting steps that were implemented from sample frame to final outcome. The process used the data from each phase of the data collection, from both the paper and Centurion (web) instruments, to produce final weights for the screened-in households, Screener children, and interviewed[2] children via the Topical.[3]

Figure 1. From Sample Frame to Final Outcome[4]

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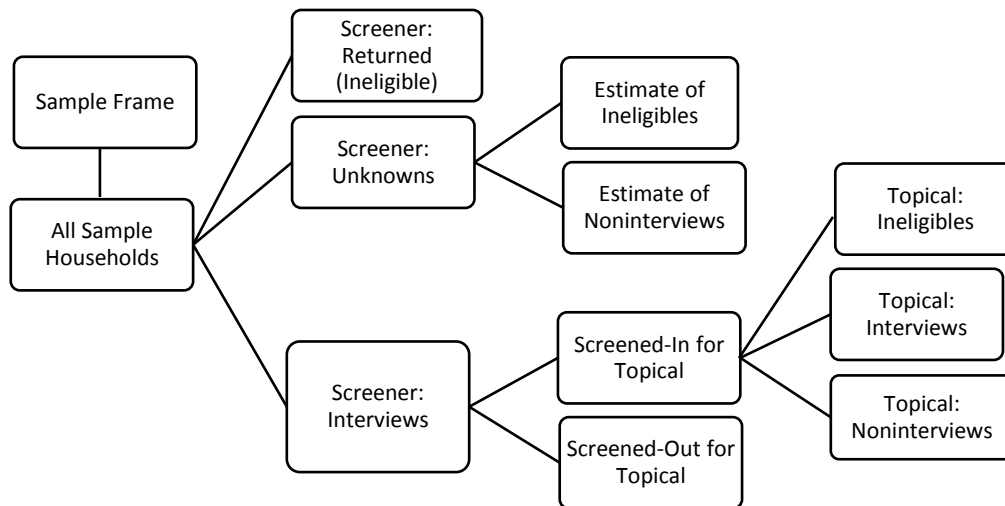
[2] Children or households are not actually interviewed in the 2016 NSCH; the term 'interviewed' is used to represent information gathered from the paper or web questionnaires.
[3] Since the household-level weight is not addressed in this report, discussion of its factors is omitted.
[4] Figure 1 shows a box representing Topical Ineligibles. An example would be a household that reports a child on the Screener, but then the child is no longer present when the Topical arrives at the household.

The weighting process for the interviewed children began with the base weight (BW) for each sample household, followed by an adjustment for Screener nonresponse (SNA). Then, the eligible children from the Screener interview cases were raked to population controls (Child-Level Screener Factor = CLSF), a within-household subsampling factor (WHSF) was applied to the Screener interview cases, and an adjustment for Topical nonresponse (TNA) was applied to the Topical interview cases. As a factor for the final weight for interviewed children, a raking adjustment (RAK) to various demographic controls, and trimming of extreme weights as necessary, was lastly performed. The weighting process for all Screener children was a subset of these six factors.

> Final Weight for Interviewed Children = BW × SNA × CLSF × WHSF × TNA × RAK
> Final Weight for Screener Children = BW × SNA × CLSF

II.   Details on Base Sampling Weights and the Adjustments for Screener and Topical Nonresponse.

Base Weights

The weighting process began with the base sampling weight for each sample household. The base weight for each sample housing unit was the inverse of its probability of selection for the Screener. Base weights were calculated separately for each of the two sampling strata[5] and each state, including the District of Columbia. If there had been no nonresponse and the survey frame was complete, using this weight would give unbiased estimates for the survey population.

Adjustment for Screener Nonresponse

Following the base weight, an adjustment for Screener nonresponse was implemented to increase the weights of the households that responded to the Screener in order to account for all of the households that did not respond to the Screener. Households were put into one of sixteen cells defined by stratum, a block-group poverty measure variable indicating the proportion of households with income less than 150 percent of the poverty rate, a measure of internet accessibility (high/medium or low), and whether they reside inside or outside of a Core Based Statistical Area (CBSA). The Screener nonresponse adjustment factor was calculated within each cell using the following formula:

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[5] Households flagged as having at least one child under the age of 18 were assigned to Stratum 1; all other households were assigned to Stratum 2.

$$\left(\frac{\text{weighted sum of Screener interviews} \ + \ \text{weighted number of Screener noninterviews}}{\text{weighted sum of Screener interviews}} \right)$$

where the number of Screener noninterviews =

$$\left(\frac{\text{weighted sum of Screener interviews}}{\text{weighted sum of Screener interviews} \ + \ \text{weighted sum of Screener ineligible households}} \right) \times$$

(weighted sum of households with unknown Screener eligibility)

In other words, the count of Screener noninterviews was an estimate of the expected number of eligible households from those cases for which nothing was received back. The term eligible here refers to the address belonging to an occupied, residential household. The expected number of eligible cases was estimated by taking the eligibility rate among the known cases and applying it to the unknown cases. The Screener nonresponse adjustment was the last step of the weight processing that included the households for which there was no Screener interview and the Screener-interviewed households that indicated no eligible children.

Adjustment for Topical Nonresponse

Similar to the Screener nonresponse adjustment, the weights of the households responding to the Topical needed to be increased to account for all of the households not responding to the Topical. If the respondent reached Section H of the Topical questionnaire and answered at least 50 percent of the key items, then it was considered a Topical interview. (Key items are 50 items on the topical instrument that are on path for all respondents.) A returned Topical that did not meet these conditions was considered a Topical noninterview.

All Topical eligible households were put into one of 96 cells depending on imputed poverty/non-poverty status (based on 150 percent poverty rate), web group (high/medium vs. low), total number of eligible children (1, 2, 3, or 4+), presence of a child with special health care needs (CSHCN), and race[6] of the selected child (White, Black, Asian, or Other). The Topical nonresponse adjustment was calculated within each of the 96 cells using the following formula:

$$\frac{\text{weighted sum of Topical interviews} \ + \ \text{weighted sum of Topical noninterviews}}{\text{weighted sum of Topical interviews}}$$

III.   File Creation for the Nonresponse Bias Analysis

Several of the approaches used to assess nonresponse bias rely heavily on the availability of information for both respondents and nonrespondents. There is normally very limited information on nonrespondents; however, since the 2016 NSCH is an address based survey, block group and tract level data from the 2015 ACS could be attached to the entire NSCH

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[6] Race is not a combination of race and ethnicity.

sample.[7] Each household is located in a single block group. The proportions (e.g., Percent White Alone) and median values (e.g., median home value) for each of the frame variables used are known for each block group or tract based on ACS data. The block group measure is assigned to each household in the associated block group. The overall median of each frame variable is then calculated and each NSCH record is put into one of two subgroups based on whether its block-group's value is above or below the overall median. Table 1 shows the information that is known for both respondents and nonrespondents, either at a geographic level or from the Screener.

For NSCH Screener interview data that were available for the Topical and NSCH frame data that were not from the ACS, median comparisons at the block group or tract levels were not necessary.[8]

<div align="center">Table 1. Information Available for Both Respondents and Nonrespondents</div>

Variable	Description
# of Eligible Children in the HH* …..	Number of children age 0-17 years in the household as indicated on the Screener
Presence of CSHCN† ……………………	Indicator of whether or not there are any CSHCN in the household as indicated on the Screener
Presence of Child Flag ………………….	Stratum Identifier: Households flagged as having at least one child under the age of 18 were assigned to Stratum 1, all other households were assigned to Stratum 2
CBSA‡ Status ………………………………….	Indicator of whether the household is inside or outside of a CBSA
Median Income ……………………………	Median income in the tract
Median Home Value ……………………	Median home value in the tract
Median Gross Rent ………………………	Median gross rent in the tract
Tenure: Percent Owner ……………….	Percent of the population in the block group that owns their home
Percent College Grad ………………….	Percent of the population in the block group that is a college graduate
Percent Hispanic …………………………	Percent of the population in the block group that is Hispanic
Percent Black Alone ……………………	Percent of the population in the block group that is Black
Percent White Alone ……………………	Percent of the population in the block group that is White
Percent Asian Alone ……………………	Percent of the population in the block group that is Asian
Percent Other Race ……………………	Percent of the population in the block group that is not Black alone, White alone, or Asian alone

* HH – Household
† CSHCN – Children with Special Health Care Needs
‡ CBSA – Core Based Statistical Area

IV.   Key Survey Estimates

As listed under the Motivation in Section I, a third goal of this analysis is to examine the relationship between the nonresponse bias in the frame variables and the bias in selected KSEs. Can what we learn about the frame variables be expected to be the same for the survey

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[7] If there were no data for a specific ACS frame variable for a block group, or if there were too many 'missings', then the ACS data for that variable were summarized to the tract level. This happened for median income, median home value, and median gross rent.
[8] The variables for which block group or tract level comparisons were not necessary include number of eligible children in the household, presence of CSHCN, stratum, and CBSA status.

estimates? The following 21 KSEs were chosen from those prioritized for assessment in the 2015 NSCH Pretest, *Nonresponse in the National Survey of Children's Health, 2007* (Skalland and Blumberg, 2012), and Appendix XIII of *Design and Operation of the National Survey of Children with Special Health Care Needs, 2009–2010 (*Bramlett et al., 2014), as well as sponsor selections.

1. Percent of children with special health care needs
2. Percent of children with any kind of emotional, developmental, or behavioral problem needing treatment or counseling
3. Percent of children with current asthma
4. Percent of children with current Autism Spectrum Disorder (ASD)
5. Percent of children with current anxiety
6. Percent of children ever diagnosed with Attention Deficit Disorder (ADD) or Attention Deficit Hyperactivity Disorder (ADHD)
7. Percent of children (6-17 years) who are bullied
8. Percent of children (1-17 years) with "excellent" condition of teeth
9. Percent of children in excellent or very good health
10. Percent of children (0-5 years) ever breastfed
11. Percent of children with a personal doctor/nurse
12. Percent of children who were ever covered by any kind of health insurance or health coverage plan during the past 12 months
13. Percent of CSHCN who were ever covered by any kind of health insurance or health coverage plan during the past 12 months
14. Percent of CSHCN whose families paid $1,000 or more out-of-pocket for medical and health care in the past 12 months
15. Percent of CSHCN whose health status caused family members to cut back or stop working in the past 12 months
16. Percent of CSHCN (12-17 years) who had at least one preventive medical visit with a doctor, nurse, or health care professional in the past 12 months
17. Percent of children (6-17 years) who exercised, played a sport, or participated in physical activity at least one day during the past week, for at least 60 minutes
18. Percent of children (1-5 years) with > 1 hour/day of TV screen time
19. Percent of children with family meals every day of the week
20. Percent of children with sidewalks or walking paths in their neighborhood
21. Percent of children where someone smokes in the household

V.   Assessing Nonresponse Bias in the 2016 NSCH

Weighted Response Rate Comparisons

As stated in Section I, a comparison of response rates across subgroups could reveal the presence of nonresponse bias in a survey. If the response rate is lower (or higher) for a particular subgroup relative to that of other subgroups, then that would indicate that the subgroup is under-represented (or over-represented) in the final sample, and, to the extent

that the key survey estimate is different for that particular subgroup compared with other subgroups, there would be bias in the overall survey estimate.

Table 2 presents the national weighted response rates for Screener respondents using the base weights and the weighted response rates for Topical respondents using the adjusted weights of all households receiving a Topical, across subgroups of the frame variables. For each of the ACS block group or tract frame variables, cases were classified into two subgroups: those with values above and those with values below or equal to the median value of the variable for all Screener or Topical respondents and nonrespondents.

With two exceptions, the response rates of all subgroups pairs are significantly different at the 95 percent confidence level. The exceptions: 1 eligible child in the household compared with 2 eligible children in the household and 3 compared with 4 or more eligible children in the household.

Table 2 shows it was more difficult to obtain screener responses from households that were placed into Stratum 1 with a 14 percentage point difference from the response rate of those that were placed into Stratum 2 (39 percent versus 53 percent). It is very likely that response is greater in Stratum 2 because there are fewer households with children, thereby easing the task of responding. Screener response rates were only 1 percentage point different for areas with less than or equal to the median of Asian populations as those with greater than the median; similarly for the variables median gross rent (2 percentage points difference) and CBSA status (4 percentage points difference). Looking at both Screener and Topical response, it was more difficult to obtain interviews from households in areas having a lower income, less homeownership, fewer college graduates, and areas with larger non-White populations (all 10 or 11 percentage points different from their median counterparts). The weighted topical response rates for number of eligible children in the household ranged from 64 percent for 4+ children to 74 percent for 1 child.

There are two limitations to this approach. First, to form subgroups, each continuous sampling frame variable had to be categorized into groups, resulting in less precise measures of these variables. Second, the adjusted response rates presented in Table 2 reflect only the weighting adjustments for nonresponse at the Screener stage and not the adjustment for nonresponse at the Topical stage or the final raking of the Topical weights to population control totals; the extent to which these additional weighting adjustments reduced the under- or over-representativeness of a particular subgroup in the final weighted sample was not captured by this analysis.

Table 2. 2016 Response Rates across Various Frame Subgroups

Frame Variable Subgroup	Screener Respondents		Topical Respondents	
	Frequency	Weighted Response Rate[9] (%)	Frequency	Weighted Response Rate[10] (%)
--- National Survey of Children's Health Screener Response Data ---				
# of Eligible Children in Household				
1………………………………………			20,810	73.73
2………………………………………			19,940	72.51
3………………………………………			6,759	66.55
4+………………………………………			2,708	63.96
Presence of Children with Special Health Care Needs				
Yes………………………………………			14,660	72.46
No………………………………………			35,550	69.46
--- Frame Data: National Survey of Children's Health ---				
Presence of Child Flag				
Stratum 1…………………………	81,250	39.16	47,020	71.19
Stratum 2…………………………	56,760	53.16	3,190	67.00
Core Based Statistical Area (CBSA) Status				
In CBSA…………………………	126,400	49.01	46,670	70.56
Not in CBSA………………………	11,590	53.30	3,546	66.02
--- Frame Data: American Community Survey Block Group or Tract Data ---				
Median Income				
≤ median………………………	59,900	44.28	18,100	64.85
> median………………………	75,980	54.41	31,160	75.01
Median Home Value				
≤ median………………………	61,120	46.45	19,720	66.43
> median………………………	73,950	52.48	29,260	74.14
Median Gross Rent				
≤ median………………………	64,050	47.99	21,110	67.56
> median………………………	69,750	50.17	27,210	72.16
Tenure: Percent Owner				
≤ median………………………	60,800	43.71	19,330	67.54
> median………………………	75,000	55.60	29,940	72.95
Percent College Graduate				
≤ median………………………	59,080	44.40	18,530	64.52
> median………………………	76,720	54.10	30,740	75.97
Percent Hispanic				
≤ median………………………	71,860	53.73	26,390	72.11
> median………………………	63,940	46.03	22,880	69.18
Percent Black Alone				
≤ median………………………	74,420	54.25	27,880	73.00
> median………………………	61,380	45.39	21,390	68.24
Percent White Alone				
≤ median………………………	60,920	44.33	20,950	68.28
> median………………………	74,880	55.39	28,320	73.11
Percent Asian Alone				
≤ median………………………	65,560	48.72	22,260	67.15
> median………………………	70,240	49.78	27,010	72.84
Percent Other Race				
≤ median………………………	71,420	52.88	26,440	71.95
> median………………………	64,380	45.92	22,830	68.98

Source: U.S. Census Bureau, 2016 National Survey of Children's Health internal data

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[9] Using BW of all sample cases.
[10] Using weights of all households receiving a Topical: BW × SNA × CLSF × WHSF

Comparing Respondents and Nonrespondents across Various Frame Variables – The Effect of the Screener and Topical Nonresponse Adjustments

For each stage of the survey (i.e., Screener and Topical), Table 3 shows a comparison of frame information for the entire sample eligible for the stage and for respondents to that stage, first using the weight before the Topical nonresponse adjustment then using the weight with the Topical nonresponse adjustment. The purpose of Table 3 is twofold: to show the bias that exists in the frame variables and to show if the Screener and Topical nonresponse adjustments were successful in reducing the bias. Ideally, we would like to see the distributions for each characteristic in the 'Using NR Adjusted Weight' columns 3 and 6 closely match the appropriate Screener or Topical bolded columns 1 and 4. For almost all frame variables, the adjustment did indeed move the distribution closer from columns 2 and 5 to that of the appropriate all sample cases column, working perfectly for two subgroups of the number of eligible children in the household. These results indicate that the adjustments mitigated a large portion of the nonresponse bias.

Using Table 3, you can calculate the bias using a variation of the following formula:

$$\frac{\text{information from respondents} - \text{information from all eligible cases}}{\text{information from all eligible cases}}$$

For example, using the base weights for the Percent Hispanic variable, the sample is biased downward 17.35 percent (calculated as (12.48 – 15.10) / 15.10 = -17.35 percent) for the Screener and biased downward 5.89 percent (calculated as (16.47 – 17.50) / 17.50 = -5.89 percent) for the Topical. Using the weights that have been adjusted for nonresponse, the sample is biased downward 11.92 percent and 0.74 percent for the Screener and Topical respondents, respectively. Thus, the nonresponse adjustments greatly lowered, but did not completely eliminate, the bias in the Percent Hispanic estimate. Table 3 shows that this is generally the case for the other frame variables as well. Nonresponse introduced small biases, but the nonresponse adjustments substantially reduced those biases. For the Topical respondents, the variable with the largest bias remaining after the nonresponse adjustments is Stratum 2 for the presence of child flag of 4.84 percent, biased downward.

Note that the presence of child flag, a poverty measure variable, and residence inside or outside of a CBSA were three of the four variables which defined the 16 weighting cells for the Screener nonresponse adjustment; a poverty/non-poverty status variable, the number of eligible children in the household, presence of a CSHCN, and the race of the selected child were four of the five variables which were used to define the 96 weighting cells for the Topical nonresponse adjustment. The results in Table 3 for their frame variable counterparts support their choice to reduce nonresponse bias. Consideration will be given to adding the presence of child flag to the Topical nonresponse adjustment in the 2017 NSCH.

Table 3. Comparing Respondents and Nonrespondents Using Frame Information

(column #):	All Sample Cases Using Base Weight (1)	Screener Respondents Using Base Weight (2)	Screener Respondents Using NR* Adjusted Weight[12] (3)	All Topical Eligible Cases Using Weight Prior NR Adjustment[11] (4)	Topical Respondents Using Weight Prior NR Adjustment (5)	Topical Respondents Using NR Adjusted Weight[13] (6)
--- NSCH† Screener Interview Data ---						
# of Eligible Children in Household						
1…………………..…………				**23.40**	24.51	23.40
2…………………..…………				**41.49**	42.75	41.49
3…………………..…………				**22.41**	21.19	22.54
4+…………………..………				**12.71**	11.55	12.58
Presence of CSHCN‡						
Yes…………………..………				**30.38**	31.28	30.84
No…………………..…………				**69.62**	68.72	69.16
--- Frame Data: NSCH ---						
Presence of Child Flag						
Stratum 1……………………	**27.98**	22.25	28.78	**80.56**	81.49	81.50
Stratum 2…………………	**72.02**	77.75	71.22	**19.44**	18.51	18.50
CBSA§ Status						
In CBSA………………….…	**94.57**	94.13	95.11	**95.89**	96.14	96.05
Not in CBSA………….………	**5.43**	5.87	4.89	**4.11**	3.86	3.95
--- Frame Data: American Community Survey Block Group or Tract Data ---						
Median Income………………..	**60,450**	63,780	62,910	**64,300**	66,740	64,810
Median Home Value…………	**236,800**	246,700	243,200	**241,100**	251,700	244,800
Median Gross Rent……………	**1,042**	1,060	1,055	**1,080**	1,101	1,084
Tenure: Percent Owner…….	**64.05**	67.86	67.11	**67.26**	68.39	67.11
Percent College Graduate…	**39.06**	41.46	40.70	**39.23**	41.09	39.73
Percent Hispanic………………	**15.10**	12.48	13.30	**17.50**	16.47	17.37
Percent Black Alone…………	**12.26**	9.84	10.55	**12.71**	11.38	12.58
Percent White Alone………..	**74.92**	78.43	77.42	**73.60**	75.20	73.76
Percent Asian Alone…………	**5.08**	5.04	5.04	**5.25**	5.41	5.27
Percent Other Race…………	**7.75**	6.70	7.00	**8.44**	8.02	8.39

Source: U.S. Census Bureau, 2016 National Survey of Children's Health internal data
* NR – Nonresponse
† NSCH – National Survey of Children's Health
‡ CSHCN – Children with Special Health Care Needs
§ CBSA – Core Based Statistical Area

[11] BW × SNA × CLSF × WHSF
[12] BW × SNA
[13] BW × SNA × CLSF × WHSF × TNA

Observed and Expected Means of Frame Variables for Respondents

Table 4 shows the observed means of the frame variables for Topical respondents and the means that would be expected under full response. The bias is calculated as the product of two ratios – the screener estimate for all sample cases over that for Screener respondents and the Topical estimate for all eligible cases over that for Topical respondents. The bias measurement is then applied to the observed values to get the expected values in Table 4.

Table 4. Observed and Expected Means of Frame Variables for Topical Respondents

	Using Weight Prior to Nonresponse Adjustment		Using Nonresponse Adjusted Weight	
	Observed	Expected	Observed	Expected
In Core Based Statistical Area (CBSA).....	96.14	96.34	96.05	95.35
Not in CBSA…………………………………….	3.86	3.80	3.95	4.56
Median Income………………………………..	66,740	60,940	64,810	61,790
Median Home Value…………………………..	251,700	231,400	244,800	234,800
Median Gross Rent…………………………..	1,101	1,062	1,084	1,067
Tenure: Percent Owner……………………….	68.39	63.48	67.11	64.19
Percent College Graduate……………………	41.09	36.96	39.73	37.65
Percent Hispanic………………………………	16.47	21.17	17.37	19.87
Percent Black Alone…………………………..	11.38	15.84	12.58	14.77
Percent White Alone…………………………..	75.2	70.31	73.76	71.22
Percent Asian Alone…………………………..	5.41	5.29	5.27	5.29
Percent Other Race……………………………	8.02	9.76	8.39	9.34

Source: U.S. Census Bureau, 2016 National Survey of Children's Health internal data

For example, using the weight before the Topical nonresponse adjustment, the observed median household income is $66,740. Taking the bias into account, the expected value is $66,740 \times (60,450/63,780) \times (64,300/66,740) = \$60,940$. Similarly, using the Topical nonresponse adjusted weight, the observed value is $64,807. Taking the bias into account, the expected value is $64,810 \times (60,450/62,910) \times (64,300/64,810) = \$61,790$.

The biases in the frame information translate into biases in the KSEs only to the extent that the frame information is related to the KSEs. To examine these relationships for each of the 21 KSEs, a logistic regression model was estimated of the following form:

$$p_i = \frac{e^{X_i'\beta}}{1 + e^{X_i'\beta}}$$

where

p_i is the probability that the *i*th respondent's child is positive for the key survey variable (e.g., has special needs, has anxiety, has sidewalks or walking paths in their neighborhood);

X_i' is a vector containing the frame information for the *i*th child; and

β is a vector of unknown parameters to be estimated.

By evaluating the fitted model first at the observed means of the frame information and then at the expected means of the frame information from Table 4, an estimate of the bias in each KSE was generated that could be attributed to biases in the frame variables due to nonresponse. These estimates of biases in the KSEs using this approach are shown in the next section's Table 5.

Estimates of Nonresponse Biases in the Key Survey Estimates

As Table 5 shows, the small biases in the frame information translate into even smaller biases in the KSEs. In this analysis, the largest sample biases found using the base weights were in the percentage of children (1-5) with > 1 hour/day of TV time, the percentage of children where someone smokes in the household, and the percentage of CSHCN whose families paid $1,000 or more out-of-pocket for medical and health care in the past 12 months. Using the nonresponse adjusted weights, this bias was cut in half for all three estimates, resulting in a downward bias of 5 percent for the percentage of children (1-5) with >1 hour/day of TV time, a downward bias of 9 percent for the percentage of children where someone smokes in the household, and an upward bias of 8 percent in the percentage of CSHCN whose families paid $1,000 or more out-of-pocket for medical and health care in the past 12 months.[14] When the standard errors of the estimates are taken into account, only the estimate using the final weights would lead to a difference large enough to be significant at the 95 percent confidence level.[15]

Although these results suggest that differences between sample respondents and nonrespondents in terms of the frame information lead to very little bias in the KSEs, this does not necessarily mean that the KSEs are biased very little. It is possible that there are differences between the sample respondents and nonrespondents that are not reflected in the frame information.

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[14] Note that the estimates of bias are not percentage points, they indicate the percent change in the observed estimate as compared to the expected estimate. A downward bias of 5 percent indicates that the current survey estimate is 5 percent lower than the "true" estimate. If the "true" estimate is 20 percent, then the survey estimate with a bias of -5 percent would be 19 percent, since (19 – 20)/20= - 5 percent.

[15] The survey estimate for KSE 14 is 19.6 percent (from Table 6) with a 95 percent confidence interval of (18.3, 20.9). Factoring in an 8 percent downward bias would lead to an estimate of 18.1 percent, since 19.6/1.08 = 18.1, which is less than the lower limit of the 95 percent confidence interval.

The results in this section do not reflect the final raking of the nonresponse-adjusted weights to population control totals. This final raking could reduce or increase bias, but if so, that reduction or increase was not captured in the analysis in this section. The next section presents analysis that makes use of the final, raked weights.

Table 5. Estimates of Nonresponse Biases in the Key Survey Estimates Attributable to Biases in the Frame Information

Key Survey Variable	Using Base Weight			Using NR* Adj. Weight		
	Model evaluated at observed respondent means of frame data[16]	Model evaluated at means of frame data expected under full response	Est. bias[17] (%)	Model evaluated at observed respondent means of frame data	Model evaluated at means of frame data expected under full response	Est. bias (%)
1. Percent of children with special health care needs (CSHCN)	19.7	19.8	-0.44	18.8	18.8	0.04
2. Percent of children with emotional, developmental, or behavioral problem needing treatment/counseling	9.4	9.6	-2.74	9.1	9.2	-1.2
3. Percent of children with current asthma	7.9	8.2	-4.59	7.8	8.0	-2.25
4. Percent of children with current ASD†	2.0	2.0	-2.04	1.9	1.9	-0.95
5. Percent of children with current anxiety	6.1	5.9	3.47	5.9	5.8	1.67
6. Percent of children ever diagnosed with ADD‡ or ADHD§	8.3	8.2	0.67	8.1	8.0	0.88
7. Percent of children (6-17) who are bullied	21.7	22.4	-3.39	21.7	22.1	-1.90
8. Percent of children (1-17) with excellent teeth condition	49.1	46.7	5.04	48.5	47.3	2.59
9. Percent of children in excellent or very good health	92.0	91.0	1.16	91.9	91.4	0.59
10. Percent of children (0-5) ever breastfed	83.2	81.4	2.12	82.5	81.7	1.05
11. Percent of children with a personal doctor/nurse	75.4	73.5	2.57	74.9	73.9	1.31
12. Percent of children who were ever covered by health insurance/plan during the past 12 months	96.8	96.3	0.56	96.6	96.4	0.30
13. Percent of CSHCN who were ever covered by any health insurance/plan during the past 12 months	98.0	97.7	0.31	98.0	97.8	0.16
14. Percent of CSHCN whose families paid ≥$1000 out-of-pocket for medical/health care in past 12 months	21.6	18.6	15.77	20.3	18.8	8.13

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[16] Although the logistic regression models were evaluated at the observed means of the frame information, the results are not the observed means of the key survey variables, as would be the case for linear regression models.
[17] (Model evaluated at observed means – Model evaluated at expected means)/Model evaluated at expected means.

Key Survey Variable	Using Base Weight			Using NR[*] Adj. Weight		
	Model evaluated at observed respondent means of frame data[16]	Model evaluated at means of frame data expected under full response	Est. bias[17] (%)	Model evaluated at observed respondent means of frame data	Model evaluated at means of frame data expected under full response	Est. bias (%)
15. Percent of CSHCN whose health caused family members to cut back/stop working in the past 12 months	13.6	14.2	-4.63	13.7	14.1	-2.67
16. Percent of CSHCN (12-17) who had ≥1 preventative visit with health care professional in past 12 months	95.6	95.9	-0.21	95.8	96.0	-0.20
17. Percent of children (6-17) physically active ≥ 1 day during past week, for ≥1 hour	91.9	91.2	0.70	91.8	91.5	0.33
18. Percent of children (1-5) with >1 hour/day of TV time	16.7	18.4	-9.07	17.2	18.1	-5.06
19. Percent of children with family meals every day	40.8	42.4	-3.82	41.4	42.3	-2.20
20. Percent of children with neighborhood sidewalks/paths	80.1	81.6	-1.94	80.2	81.3	-1.35
21. Percent of children where someone smokes in the household	1.1	1.3	-17.48	1.2	1.3	-8.96

Source: U.S. Census Bureau, 2016 National Survey of Children's Health internal data

[*] NR – Nonresponse

[†] ASD – Autism Spectrum Disorder

[‡] ADD – Attention Deficit Disorder

[§] ADHD – Attention Deficit/Hyperactivity Disorder

VI. Comparison to Similar Estimates from Other Sources

Table 6 provides a comparison of several 2016 NSCH KSEs, and a few additional health-related measures, to estimates from the following other surveys:

- 2016 National Health Interview Survey (NHIS)
- 2015 NHIS
- 2014 NHIS
- 2011-2012 NSCH
- 2009-2010 National Survey of Children with Special Health Care Needs (NS-CSHCN)

When considering the estimates and their 95 percent confidence intervals, the following six 2016 NSCH estimates are comparable to those of other surveys:

- Percent of children with special health care needs (KSE 1)
- Percent of children with current asthma (KSE 3)
- Percent of children ever diagnosed with ADD or ADHD (KSE 6)
- Percent of children who missed 11 or more days of school in the past 12 months because of illness or injury

- Percent of children uninsured at the time of interview
- Percent of children who received a well-child (preventative) checkup in the past 12 months

Notable differences are found for the following estimates:
- Percent of children in excellent or very good health (KSE 9) -2016 NSCH estimate is higher
- Percent of CSHCN whose families paid $1,000 or more out-of-pocket for medical and health care in the past 12 months (KSE 14) – 2016 NSCH estimate is lower
- Percent of children with family meals every day of the week (KSE 19) – 2016 NSCH estimate is lower
- Percent of children who have a usual place for sick care – 2016 NSCH estimate is lower

Table 6. Comparison of Several 2016 Estimates to Similar Estimates from Other Surveys

Estimates from the 2016 NSCH[*] and Other Surveys	Using Weight Prior NR[†] Adj.	Using NR Adj. Weight	Using Final Weight	95 Percent Confidence Interval
Percent of children with special health care needs (KSE 1)				
2016 NSCH (Screener)..	19.0	19.0	18.9	(18.4, 19.4)
2016 NSCH (Topical)..	19.6	18.7	19.4	(18.6, 20.1)
2011-2012 NSCH..			19.8	(19.2, 20.4)
Percent of children with current asthma (KSE 3)				
2016 NSCH...	7.9	7.9	8.4	(7.9, 8.9)
2011-2012 NSCH..			8.8	(8.4, 9.2)
2015 NHIS[‡]...			8.4	(7.7, 9.1)
Percent of children ever diagnosed with ADD or ADHD (KSE 6)				
2016 NSCH, aged 3-17...	9.8	9.6	9.9	(9.4, 10.5)
2015 NHIS, aged 3-17..			9.8	(9.0, 10.6)
Percent of children in excellent or very good health (KSE 9)				
2016 NSCH...	91.3	91.1	89.7	(89.0, 90.4)
2011-2012 NSCH..			84.2	(83.6, 84.7)
2015 NHIS..			84.4	(84.0, 84.8)
2014 NHIS..			84.7	(83.9, 85.5)
2011-2012 NHIS...			83.1	(82.5, 83.8)
Percent of CSHCN whose families paid ≥ $1,000 out-of-pocket for medical & health care in the past 12 months (KSE 14)				
2016 NSCH...	23.0	21.9	19.6	(18.3, 20.9)
2009-2010 NS-CSHCN[§]...			22.1	(21.4, 22.8)
Percent of children w/ family meals every day of week (KSE 19)				
2016 NSCH...	41.0	41.6	43.2	(42.2, 44.2)
2011-2012 NSCH..			46.7	(46.0, 47.4)
2007 NSCH...			45.8	(45.0, 46.6)
Percent of children who have a usual place for sick care				
2016 NSCH...	82.0	81.4	79.7	(78.8, 80.6)
2016 NHIS..			95.1	(94.6, 95.6)
2015 NHIS..			96.0	(95.5, 96.5)

Estimates from the 2016 NSCH* and Other Surveys	Using Weight Prior NR† Adj.	Using NR Adj. Weight	Using Final Weight	95 Percent Confidence Interval
2014 NHIS..			96.3	(95.9, 96.7)
Percent of children who received a well-child (preventative) checkup in the past 12 months				
2016 NSCH...	84.1	83.5	82.3	(81.4, 83.1)
2014 NSCH...			83.8	(83.0, 84.6)
Percent of children who missed 11 or more days of school in the past 12 months because of illness or injury				
2016 NSCH...	3.7	3.6	3.9	(3.5, 4.4)
2014 NHIS..			3.6	(3.1, 4.1)
Percent of children uninsured at the time of interview				
2016 NSCH...	4.6	4.9	5.7	(5.1, 6.2)
2016 NHIS..			5.1	(4.5, 5.7)
2015 NHIS..			4.5	(4.0, 5.0)
2014 NHIS..			5.5	(5.0, 6.0)

Sources: U.S. Census Bureau, 2016 National Survey of Children's Health internal data
National Center for Health Statistics, 2014, 2015, and 2016 National Health Interview Survey external data
Data Resource Center for Child and Adolescent Health, 2011-2012 National Survey of Children's Health external data and 2009-2010 National Survey of Children with Special Health Care Needs external data

* NSCH – National Survey of Children's Health
† NR – Nonresponse
‡ NHIS – National Health Interview Survey
§ NS-CSHCN – National Survey of Children with Special Health Care Needs

In comparing the 2016 NSCH to the NHIS, the NSCH over-estimates the percent of children with excellent or good health while under-estimating the percent of children with a usual place for sick care. While the result of the first comparison is consistent with an over-representation of higher income, the second one is not. In comparing the 2016 NSCH to the previous NSCH in 2007 and 2011 and the 2009 NS-CSHCN, the current NSCH under-estimates the percent of CSHCN whose families paid $1,000 or more out of pocket for health care and the percent of children with family meals every day of the week. But, there is a 5-9 year difference in the estimates. It is highly possible that a real change has occurred. And if no change has occurred, and the assumption is that higher income households pay more out-of-pocket for health care and are more likely to have family meals every day, then these results do not lend support to the idea that the NSCH over-represents higher income households. Additionally, disparities in the estimates could very well be due to mode effects. While the 2016 NSCH was solely a mail and web survey, the NHIS is conducted in-person and the previous NSCH and NS-CSHCN were phone-based interviews. It is possible that having no interviewer present in the current NSCH contributed to some of the differences observed here.

VII.   Conclusions

Assessing the extent to which nonresponse produces biased survey estimates is difficult. This analysis has applied the most commonly used methods, each of which has its shortcomings. By taking multiple approaches, it was hoped that reasonably accurate conclusions about the level of nonresponse bias in KSEs could be drawn.

Generally, the results indicate that the interviewed population was more likely to live outside of a CBSA (Table 2). The interviewed population also was more likely to live in areas associated with higher levels of income, home ownership, home values, and monthly rents. Additionally, the interviewed population was more likely to live in areas associated with a greater percentage of college graduates and non-Hispanic White persons.

Table 5 presents estimates of bias for each KSE. The largest estimates of bias were associated with the percentage of children (1-5) with >1 hour/day of TV time, the percentage of children where someone smokes in the household, and the percentage of CSHCN whose families paid $1,000 or more out-of-pocket for medical and health care in the past 12 months. For each of these estimates, the nonresponse adjusted weights reduced the bias by 50 percent. The bias remaining in the nonresponse adjusted estimates are estimated to be -5 percent, -9 percent, and 8 percent, respectively. But, when the standard errors of the survey estimates are factored in, only the last bias estimate reveals a difference that would be significant at the 95 percent level.

Table 6 compares ten 2016 NSCH estimates to similar estimates from other surveys. While some differences exist between the 2016 NSCH estimate and the similar estimate from another survey, often there are differences in the timing of the data collection and the mode of the data collection. The NSCH estimate of the percent of children with excellent or good health was larger than the NHIS estimate, but no evidence of bias was found for this estimate in the previous analysis (Table 5). Similarly, the percentage of CSHCN whose families paid $1,000 or more out-of-pocket for medical and health care in the past 12 months was found to have an upward bias in the earlier analysis, but was found to be lower than the estimate from a prior survey.

Taking all these analyses into account, there is no strong or consistent evidence of nonresponse bias in the 2016 NSCH. Although, response was higher where income was higher. And while the weighting did have a positive effect in reducing the difference between respondents and the full sample, it did not completely remove the differences related to income. Consequently, there is a possibility that some bias related to income remains in the 2016 NSCH estimates. But, the analysis of the estimates in Tables 5 and 6 did not provide consistent support for an income bias. Therefore, the expectation is that if an income bias exists, it is small.

VIII.   References

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